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XII.—GALLS ON AN INDIAN GRASS.

(With Plate.)

L. A. Boodle.

Some interesting specimens of a grass were sent to Kew in 1908 by Mr. W. A. Talbot, F.L.S., Conservator of Forests, Bombay. The specimens are portions of plants of *Ischaemum pilosum*, Hack., and the peculiar feature about them is the presence of upright leafless branches of a rather striking appearance.

Mr. Talbot, who was inclined to regard these specialised branches as pneumatophores, forwarded a number of specimens to Kew for further examination, with some notes giving his own observations on their appearance and occurrence.

An examination of these specimens has proved that the modified branches are really galls, the formation of which depends on the presence of a gall-insect. The material shows the nature and mode of formation of the gall, but does not include enough stages to render a complete account possible. It is to be hoped, therefore, that Mr. Talbot will be able to make further observations on the living plants, and to obtain a fuller history of the gall and the insect than can be given at present.

Before describing my own observations on the structure of the galls, it will be useful to make some extracts from Mr. Talbot's notes :—

"*Ischaemum pilosum*, Hack., a widely distributed species throughout the Deccan peninsula, Central Provinces, and other parts of the dry Indian region, grows, as far as I know, on all kinds of soil, and is particularly common on the Deccan Regur, which overlies the Trap, and in which it develops an extensive perennial underground system. The rhizomes are long, tough and wiry, somewhat resembling whipcord in appearance, and ramify below the surface of the ground, sometimes as deep down as 18 inches or 2 feet."

The Deccan Regur is described as a "hygroscopic plastic black soil, which contracts and expands in a remarkable degree under different conditions of moisture and dryness. After the first showers in June, when the hot season is over, the deep gaping fissures, which divide up the black soil into irregular masses, close, and the whole is converted into a highly plastic and impermeable

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mass." It was partly on account of this character of the soil that Mr. Talbot was led to regard the specialised branches as pneumatophores.

The galls of *Ischaemum pilosum* are described by Mr. Talbot as "peculiar, red-coloured axile organs,* clothed with sheathing white scales at the base, and somewhat resembling slender goose-quills in shape and thickness . . . They are conspicuous objects during June, July and August, when the rainfall in the Deccan is heaviest, on the black soil about Poona."

The mature gall may be described as a cylindrical tube, pointed at the apex, and sheathed at the base by scale-leaves (Fig. 1). Its length, in the specimens sent to Kew, varied from 11 to 18 cm., and its diameter from 3 to 4 mm. The pointed tip of the gall consists of an indurated, rolled leaf-rudiment, 1–2 mm. in length,† beneath which is a short solid portion of stem, or diaphragm. The hollow portion extends from this diaphragm to the insertion of the highest scale-leaf, *i.e.*, for practically the whole length of the gall, and thus represents a single greatly elongated internode. A longitudinal section of the gall is shown in Fig. 2.

In the mature gall the internodal cavity is empty, but there is a small hole near the top, *i.e.*, just below the diaphragm. This hole has evidently been made by the gall-insect for its escape, and, in several specimens, part of the pupal skin of the insect was found wedged in this aperture and protruding from it (Fig. 1, *i.*).

Prof. J. W. H. Trail, F.R.S., to whom I am much indebted for information on several points relating to the formation of galls, kindly examined the pupal skins, and found their structure to indicate that they belong to one of the Cecidomyidae. The pupal skins bear small spines directed backwards, and it must be with the aid of these spines that the insect wriggles its way to the top of the gall.

The origin of the gall appears to be as follows : The larva of the gall-insect finds its way into the meristematic tissue of the stem immediately below the youngest leaf-rudiment of the bud,‡ with the final result that the youngest leaf remains rudimentary, that no further apical growth takes place, and that the highest internode becomes hollow, and also abnormally elongated owing to long-continued intercalary growth at its base. Comparison with a normal branch shows that the internodes of the stem, at a level corresponding to that of the gall, are solid, only 4–5 mm. in length, and have the vascular bundles scattered over the greater part of the transverse section (Fig. 11), while in the gall-internode the bundles show an approximation to arrangement in a single circle (Fig. 10 and Fig. 12, which is a portion of a transverse section of a gall enlarged to the same scale as Fig. 11). The vascular bundles in the gall

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* The specimens were sent in spirit, and consequently the colouring matter had been extracted.

† In Fig. 1 the length of the leaf-rudiment is shown by the longitudinal line or slit at the apex ; this line, which may be inconspicuous, indicates the outer margin of the rolled leaf.

‡ It is assumed that the larva bores its way into the tissue of the stem, because, as Prof. Trail informs me, the ovipositor of the female Cecidomyid is usually not strong enough to bore into plant-tissues. Possibly, however, this particular insect may form an exception.

are more numerous, and on the average smaller than in the normal internode. They also differ somewhat in structure, as will be described below. Thus the presence of the insect, in the successive stages of larva and pupa, causes considerable modifications in the structure and development of the internode, the most striking feature being the excessive intercalary growth of the gall. The latter may attain a length of more than thirty times that of the normal internode.

Among the material examined there were a few galls in an early stage. It is probable that they would have developed into mature structures like those described above, but with the difference that the leaves immediately sheathing the base of the gall were not scale-like, but had developed a lamina. This difference is presumably due to the bud having been attacked at a slightly different stage. A branch with one of these young galls is shown in Fig. 3. This specimen is only distinguished from a normal branch by the slight swelling near the base. On removing the leaves, the swollen internode is seen surmounted by the youngest leaf-rudiment (Fig. 4). The insect, which is in the larval stage, nearly fills the internal cavity of the gall, as is seen in the enlarged longitudinal section (Fig. 5).

Specimens of this larva, and of the pupal skins from mature galls, were sent to Prof. J. J. Kieffer, who kindly examined them, and wrote the following description for publication.

"*Oligotrophus ischaemi*, sp. nov.—Larve blanche, longue de 2 mm., lisse ; verrues spiniformes très fines, situées sur la partie ventrale des deux derniers segments thoraciques et de tous les segments abdominaux ; toutes les papilles sont simples, sauf les huit terminales, qui sont pourvues d'une soie très courte et peu distincte; papilles pleurales et sternales assez grandes, les pleurales internes disposées par groupes de trois ; papilles ventrales antérieures et postérieures petites et peu apparentes. Segment anal arrondi, légèrement échancré au milieu ; sa partie dorsale porte, à sa base, quelques granulations éparses, et dans sa moitié postérieure, des téguments subplans.

"Spatule jaune, grande, sessile, aussi longue que large, munie en avant, de deux dents triangulaires qui sont deux fois aussi longues que larges à leur base, et séparées l'une de l'autre par une incision largement arquée. Nymphe à peau hyaline ; spinules dorsales fortes, jaunes, disposées en 3 à 4 rangées ; stigmates thoraciques 3 à 4 fois aussi longs que gros, cylindriques et épais."

With regard to the generic determination Prof. Kieffer adds :—

"Le genre *Oligotrophus* est voisin de *Mayetiola ;* si la pupe est une coque brune, l'insecte serait un *Mayetiola*, quoique tous les *Mayetiola* connus aient la peau couverte de téguments et non lisse, à l'état larvaire."

Among the mature galls one exceptional case was met with (Fig. 6). The gall was of the usual type except that there were three small holes (Fig. 6*a*), instead of the single rather larger one, and also the gall was not empty, but contained, as Prof. Kieffer determined, a distended skin (of the gall-insect) inhabited by specimens of a parasitic insect belonging to the genus *Platygaster* (Fig. 6, *s.*). The gall-insect had clearly been killed by the

parasites, some of which had escaped by the three holes referred to above, while three mature insects were still to be seen within the skin of the gall-insect.

A younger gall (Fig. 7) appears to be another example of the same kind. The body inside this gall (Fig. 8, *i.*) is described by Prof. Kieffer as a skin containing larvae of parasitic Hymenoptera. These may well belong to the same species as the parasitic insects mentioned in the last case. It is interesting to find that the position of the puncture, marking the point of entry of the larva of the gall insect,* can be seen in this specimen. In the uppermost sheathing leaf there is a small hole (Fig. 7, *p.*), and in the enclosed hollow internode there is a small tuft of hairs (Fig. 8, *h.*). This no doubt marks the point of puncture ; the tissue, being meristematic at the time, closed up again, but the irritation involved has caused the formation of a patch of hairs on the otherwise glabrous internode of the gall. The elongation of the leaf had been greater than that of the gall-internode, so that the hole in the former and the hairs on the latter were not opposite one another, though in the same vertical line.

A transverse section of the leaf-rudiment from the apex of a normal mature gall is shown diagrammatically in Fig. 9. The parenchymatous cells of the mesophyll have thick walls and are practically devoid of contents ; the vascular bundles are collateral.

The structural difference between the vascular bundles of the normal internode and those of the gall is shown in Figs. 13 and 14. A medium-sized bundle was chosen for illustration in both cases. The bundle from the gall (Fig. 14) shows considerable reduction in the size of the xylem-vessels and the elements of the phloem. This reduction in the size of the conducting elements of the vascular bundles is a marked feature in all the galls examined, and, in the case of the vessels, may be carried further than in Fig. 14, even in the largest bundles of a gall. This reduction may perhaps be connected with the rudimentary nature of the single leaf above the gall and the cessation of apical growth.

Prof. Trail informs me that he has found a somewhat similar gall in *Agropyrum repens*,† but that certain characters of the gall in *Ischaemum* and of the insect producing it are exceptional. Thus the great elongation of the internode is unusual, since Houard,‡ in referring generally to terminal stem-galls in the grasses, states that, in consequence of the presence of a larva in the medullary tissue, the elongation of the upper internodes does not take place. The insect also is of an unusually large size for a member of the Cecidomyidae. The pupal skin, though incomplete and curtailed in length, when found attached to the mature gall of *Ischaemum*, may measure 6 mm.

The foregoing account will serve to show that the galls of *Ischaemum* present several interesting features, and should repay a further study.

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* Or possibly a perforation made by the ovipositor of the parasitic insect. On the other hand the egg of the parasite may be laid on the larva of the gall-insect while it is still outside the stem.

† *Cf.* Houard, Ann. Sci. Nat. Bot., sér. 8, p. 360, t. 20.

‡ Houard, Les Zoocécidies des Plantes d'Europe (1908), vol. 1, p. 59.

Ischaemum pilosum appears to have some economic importance, since Watt* states that it is "considered a good fodder grass in the Nimar district." The gall-insect probably does no great amount of damage, as Mr. Talbot writes that the galls are not found on plants growing in porous soils, and that, where the galls occur, they are somewhat sparsely distributed.

Explanation of Plate.

All the figures are of *Ischaemum pilosum*.

Fig. 1.—External view of mature gall showing sheathing scale-leaves at the base and the pupal skin of the gall-insect (*i.*) sticking out of a hole near the apex of the gall. Nat. size.

Fig. 2.—Longitudinal section of the same gall showing the extent of the cavity (*c.*). Nat. size.

Fig. 3.—Branch bearing two well-developed leaves and a young gall enclosed in the leaf-bases. Nat. size.

Fig. 4.—The same after the removal of the leaves. Nat. size.

Fig. 5.—The same gall cut longitudinally and enlarged, showing the larva (*i.*) in the cavity. × 5.

Fig. 6.—Gall containing skin of gall-insect with parasites. The position of the skin is shown at *s*. Nat. size.

Fig. 6*a*.—Upper part of same gall seen from the left side to show the three small holes. Nat. size.

Fig. 7.—Young gall covered by its sheathing leaves; *p*. puncture in upper leaf. Nat. size.

Fig. 8.—The same after removal of the leaves; *h*. group of hairs; *i*. skin of gall-insect containing parasitic larvae; at *b*. the tissues of the gall are mature, at *a*. they are meristematic. Nat. size.

Fig. 9.—Transverse section of leaf-rudiment from the apex of a mature gall. × 30.

Fig. 10.—Transverse section of a mature gall near the middle of its length. × 8.

Fig. 11.—Transverse section of normal internode. × 30.

Fig. 12.—Portion of transverse section of a gall. × 30.

Fig. 13.—Transverse section of vascular bundle of normal internode. × 305.

Fig. 14.—Transverse section of vascular bundle of gall. × 305.

XIII.—DECADES KEWENSES

Plantarum Novarum in Herbario Horti Regii Conservatarum.

DECAS LVI.

551. **Corydalis spathulata**, *Prain MSS. in Herb. Calcutta, ex Craib* [Papaveraceae-Fumarieae]; ad *C. mucroniferam*, Maxim., et *C. Boweri*, Hemsl., habitu accedit sed bracteis ovularumque numero differt.

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* Watt, Dict. Econ. Prod. India.

Herba pusilla, caespitosa, 2–4·5 cm. alta, omnino glabra. *Radix* tenuis, fusiformis, elongatus, circiter 2 mm. latus. *Caulis* dense ramosus, ramulis diffusis dense caespitosis. *Folia* radicalia longe petiolata, petiolo 2–5 cm. longo ; lamina 0·8–1·5 cm. longa, 0·7–1 cm. lata, crassa, spathulata, pinnatim 3–5-secta, segmentis subsessilibus late orbiculatis 3-fidis, lobulis obovatis, imbricatis, distincte mucronatis, nervis obscuris. *Racemi* immersi. *Bracteae* foliosae, ambitu obovatae, trisectae, circiter 1 cm. longae, basi 1 mm. latae ; segmentum intermedium simplex, lineari-spathulatum, apiculatum, lateralia eodem modo trisecta nisi segmentulis lateralibus interdum inciso-serratis. *Flores* minuti, 7–8 mm. longi, calcari obtuso 2–3 mm. longo, pedicello circiter 6 mm. longo. *Sepala* persistentia, minuta, elliptica, antice irregulariter paucidentata. *Petalum* inferius cochleariforme, lateralibus spathulatis. *Staminum* adelphii infra medium subito dilatati. *Ovarium* ellipsoideum, 9-ovulatum, stylo 4 mm. longo stamina aequante. *Stigma* 3-lobatum crenatumque. *Capsula* pedicello arcte recurvo insidens oblonga, 1·5–2 mm. alta, circiter 1 mm. lata, saepissime 4–5-sperma, stylo persistente arcte recurvo coronata. *Semina* nigra, nitida, reniformia, circiter 1·5 mm. lata, 1 mm. alta.

Tibet. Gyantse, *H. J. Walton* ; Numa, *H. M. Stewart*.

552. Impatiens Hubertii, *Hk. f.* [Geraniaceae - Balsamineae] ; affinis *I. Blumei*, Zoll. et Mor., sed petiolis 1–3 cm. longis et seminibus laevibus 1·5 mm. longis differt.

Herba gracilis, erecta, ± 7·5 cm. alta, fere glaberrima, parviflora, caule basi repente parce ramoso, ramulis novellis puberulis. *Folia* 3–5 cm. longa, petiolata, ternatim verticillata, firma, ovata vel rotundata, acuta, minute spinuloso-serrulata, basi acuta, subtus pallida, nervis utrinque 5–6, petiolo gracillimo 1–3 cm. longo ; glandulae infrapetiolares minutae, setaceae. *Inflorescentia* simpliciter pedicellata ; pedicelli in axillis foliorum solitarii, foliis subaequilongi, graciles, erecti. *Flores* ad 1·5 cm. expansi, albi. *Sepala* 2, ovata, acuminata, 6–7 mm. longa, 3–5-nervia. *Vexillum* oblate trigonum, angulis rotundatis, 12 mm. latum, costa dorso carinata, carina medio incrassata, apiculata. *Alae* sessiles, 12–14 mm. longae ; lobus basalis obovato-oblongus, apice retusus ; distalis duplo major, late obcordatus ; auricula dorsalis obscura. *Labelli* limbus scaphiformis, ascendens, fere erectus, ovatus, acuminatus, 6–10 mm. longus ; calcar gracillimum, pendulum, 3–3·5 mm. longum. *Filamenta* brevia, subulata ; antherae minutae, connatae. *Ovarium* ovoideum, obtusum. *Capsulae* 12–13 mm. longae, anguste ovoideae, fere rectae, vix stipitatae, obtuse rostratae, polyspermae. *Semina* minima, 1·5 mm. longa, pyriformia, compressa, laevia, atra.

Borneo austro-orient. Inter Kumam et Slinau, *H. Winkler*, 2939.

I. Huberti is most nearly allied to *I. Blumei*, Zoll. & Mor., from Java, a much smaller flaccid species, with shortly petioled leaves and pilose seeds nearly twice as large.

553. Impatiens orthosepala, *Hk. f.* [Geraniaceae - Balsamineae] ; affinis *I. Hubertii*, Hk. f., sed vexilli magnitudine et sepalorum forma valde diversa.

Herba erecta, gracilis, glaberrima, parviflora, caule ramoso rigido, ramis ramulisque erectis. *Folia* 4–5 cm. longa, opposita et

alterna, petiolata, firma, ovata, acuminata, spinuloso-serrulata, subtus pallida, basi breviter in petiolum gracilem 1–3 cm. longum angustata, nervis utrinque 3–4 ; glandulae infrapetiolares minimae, setaceae vel 0. *Inflorescentia* simpliciter pedicellata ; pedicelli foliis subaequilongi, solitarii, gracillimi. *Flores* ad 2 cm. expansi, lilacini. *Sepala* 8–11 mm. longa, anguste ovato-lanceolata, longe acuminata, striata, 5-nervia. *Vexillum* magnum, oblate trigonum angulis rotundatis, 12 mm. latum, costa dorso tenue apiculata medio paullo incrassata. *Alae* sessiles, 12 mm. longae ; lobus basalis obovato-oblongus, apice retusus vel subbilobus, distalis triplo major, late obcordatus ; auricula dorsalis 0. *Labelli* limbus scaphiformis, lanceolatus, fere erectus, acuminatus, 1–1·2 cm. longus ; calcar gracillimum, 4–4·5 cm. longum, dependens.

Borneo austro-orient. Inter Tarik austral. et Kwaru, secus ripas rivulorum, *H. Winkler*, 3050.

The specimens described are scanty and imperfect, but the species is so distinct from any known to me that I have not hesitated to describe it. It is clearly closely allied to *I. Hubertii*, with which it precisely accords in the form of the wings, but in the size of the vexillum and form of the sepals they widely differ.

554. **Impatiens Winkleri**, *Hk. f.* [Geraniaceae-Balsamineae] ; inter omnes species ex insulis Malayicis hucusque notas lobis alae distalibus plus minusve connatis distincta.

Herba humilis, robusta, glaberrima, floribus mediocribus, caule plus minusve 1 m. alto simplice 2–3 cm. crasso carnoso. *Folia* ampla, 1–1·3 cm. longa, alterna, petiolata, exsiccata membranacea, late ovata, cuspidata, minute serrulata, basi acuta, nervis utrinque 10–15, petiolo crasso 6–10 cm. longo ; glandulae infrapetiolares 0 ? *Inflorescentia* simpliciter pedicellata ; pedicelli solitarii, graciles, 1–2 cm. longi, fructiferi 2-3-plo longiores. *Flores* ad 3 cm. expansi, rosei brunneo-punctati. *Sepala* 2, orbicularia, cuspidata, membranacea, reticulatim multinervia, 1·2 cm. diametro. *Vexillum* oblongum, 1·4 cm. longum, recurvum, basi et apice rotundatum, costa dorso anguste alata, ala apice truncata. *Alae* sessiles, 2 cm. longae ; lobi basales liberi, falcatim obovati, distales basalibus aequilongi, late dolabriformes vel semilunares, apicem versus repente angustati ; auriculae dorsales connatae. *Labelli* limbus 1·7 cm. longus, cymbiformis, horizontalis, acuminatus; calcar limbo multo brevius, incurvum, crassum, apice bifidum. *Filamenta* brevia, linearia ; antherae parvae, in capitulum decurvum connatae. *Ovarium* angustum, apice acuminatum incurvum. *Capsula* parva, 12 mm. longa, anguste ellipsoidea, longe stipitata et rostrata, rostro recto pugioniforme, oligosperma. *Semina* 2·5–3 mm. longa, oblonga, pilis inarticulatis hirsuta.

Borneo austro-orient. Inter Batu Babi et Lumovia, *H. Winkler*, 2866.

I. dempoana, Hk. f. ined., of Sumatra, and *I. Winkleri* are the only species of about 55 known to me as native of the Malayan Archipelago (extending from Sumatra to the Philippine Islands) in which the distal lobes of the wings are more or less connate, a character common to many Indo-Chinese and a few Malay Peninsula species.

Dr. Winkler describes the flowers as white, the four lobes of the lower lip (alae) as rose-coloured with brown dots along the inner margin, and the central crest (vexillum ?) as yellow.

555. **Anaphalis deserti**, *J. R. Drummond* [Compositae-Inuloideae-Gnaphalinae] ; e grege *A. Hookeri*, cum *A. subumbellata* et *A. araneosa* comparabilis ; ab *A. Hookeri*, *A. subumbellata* et *A. xylorrhiza*, praeter alia signa, foliorum basi decurrente,—ab *A. araneosa* (inclusa *A. semidecurrente*, Wall.) ob phyllaria sensim attenuata et inflorescentiam compactam distincta.

Herba perennis pedalis vel sesquipedalis. *Caules* 2–4 e rhizomate procumbente ligneo gemmifero ascendentes sarmentosi, tenues, teretes, castanei coloris. *Folia* oblongo-linearia apice rotundata, margine plana, uninervia, superiore pagina atroviridi glabrescente, inferiore cinereo-puberula, ad 5 cm. longa, 5 mm. lata, anguste decurrentia, sub capitula araneosa. *Capitula* parva, in glomerulos folia superna vix supereminantes ad 15–20 conferta, flavescentia. *Phyllaria* exteriora fulva, obovata, circa 7 mm. longa, interiora albo-nitida sub-pellucida ovato-lanceolata obtuse acuminata, omnia sensim attenuata, scariosa. *Achaenia* minutissima, sub-cylindrica, supra sparse glandulosa, infra obscure costata, pappo multo longiore albescente scabro uniseriato libero coronata.

India. Eastern Himalaya : Lonok, *Younghusband*. Tibet. Near Gyantse, *Stewart*.

556. **Leontopodium fimbrilligerum**, *J. R. Drummond* [Compositae-Inuloideae-Gnaphalinae] ; ab omnibus speciebus *Leontopodii* adhuc descriptis propter pappum antenniformem bene distinctum, et ita *Antennariis* vel quibusdam speciebus *Gnaphalii* approximans, sed habitu et capituli structura manifeste congener *Leontopodii alpini*, a quo phyllariis interioribus margine laceris apice fimbrilligeris statim discernitur.

Herba spithamea, caespitosa, (dioica ?), rhizomate perenni intricate ramoso castaneo tenaci caules plures foliosas pseudo-monocephalas edente. *Folia* radicalia subverticillata, 12 mm. vel plus longa, lineari-spathulata, sub apicem obtusiusculam lente dilatata, dense lanata, caulina consimilia sessilia subremota, involucralia iis longiora, acutiora, capillis longis sericeo-villosis demum fulvescentibus copiose vestita. *Capitula* [♀ visa tantum ?] subconica, exigua, pauciflora, villosa, quinque vel plura super receptaculum commune plano-convexum circa 7·5 mm. latum glomerata. *Phyllaria* exteriora villis laxis fulvescentibus celata, interiora oblanceolata, scariosa, sub-purpurea, intus glabrescentia, margine lacere pinnatifido, apice fimbriato. *Flosculi* subtruncati, fusci. *Pappi* setae basi liberae, barbellatae, versus apicem clavatae (antenniformes), flosculos superantes. *Fructus* non visi.

India. Eastern Himalaya : Chumbi valley, at about 3350 m., *King's collector*.

The above description follows so far as possible a MS. note by the late Sir George King, who adds : " this has the general facies of *L. alpinum*, but is readily distinguished by the yellow involucral leaves and by the fimbriate involucral scales." In habit the plant is a *Leontopodium*, but the clavate toothed pappus-hairs recall *Antennaria* or certain species of *Anaphalis*. Their insertion is

peculiar, seeming to be partly at least at the base of the corolla-tube, but the material is imperfect; and for the same reason it cannot be said whether the sexes are completely diclinous.

The specific name refers to the very remarkable structure of the phyllaries, which is quite unlike that in any known species of *Leontopodium*, except the next, though having analogies in *Gnaphalium*.

557. **Leontopodium paradoxum**, *J. R. Drummond* [Compositae-Inuloideae-Gnaphalinae]; species nulli *Leontopodii* speciei arcte affinis, habitu nonullas species *Filaginis* revocans, ob pappum omnino liberum in eadem sectione cum praecedente locanda, et, praeter illam, ab omnibus *Leontopodiis* eodem charactere distinguenda.

Herba nana vel procumbens, subcaespitosa, (dioica?), rhizomate perenni ligneo-fibroso in caules 2 vel plures sarmentosos, infra denudatos, superne saepius arcuatos et lanatos, capitulorum glomeris seu foliorum verticillis terminatos subito diviso. *Folia* radicalia pauca vel omnino absentia, sparsa vel rosulatim (internodis abbreviatis) congesta, margine integro vix undulato, ex angusta basi sessili lineari-spathulata, apice obtusiusculo, nervo unico ex inferiori pagina eminente, utrinque candide appresse lanata, circa 12·5 mm. longa, vix 4 mm. lata, involucralia longiora, ovata, et acutiora, superiore pagina villis candidis vel demum fulvescentibus laxe intertextis quasi incunabulum conformantibus copiose munita. *Capitula* [♂ tantum in speciminibus hodiernis visa?] exigua, subcylindrica, pauciflora, glabra, quatuor vel plura super incunabulum circa 12·5 mm. latum laxe disposita; receptaculum minutum umbonatum late alveolatum. *Phyllaria* quinque vel plura, glaberrima, basi angustata, supra late spathulata, ungue subpellucido atro-lineato arguto, limbo ample rotundato plus minus sub marginem lacerato sub-purpureo, demum stellulatim patentia; [flosculi etc. in speciminibus hodiernis non visi]. *Pappi* setae liberae.

India. Eastern Himalaya: hill behind Tangu Bungalow, 4360 m., *Younghusband*, *T.* 51; Tangu 3660 m., *Prain*. Also collected (in Tibet) by *Col. Waddell*, and at Wallanchon (border of Nepal) by *Sir J. D. Hooker*.

Sir Joseph Hooker gave this plant the manuscript name of *Anaphalis sessiliflora*, with regard to the distinct pappus hairs; but if the present specimens belong to the same species the genus should apparently be *Leontopodium*. He has observed (Fl. Brit. Ind. iii. 279), that in some species of *Anaphalis* the disk-flowers are all fertile, thus breaking down the character between this genus and *Gnaphalium*, and adds, "in fact the differences between these genera and *Helichrysum*, *Antennaria*, and *Leontopodium* are artificial, and hardly sufficient for practical purposes."

That characters mainly founded on the pappus are of less value than was formerly supposed in this group of *Inuloideae* appears certain, but the structure of the inflorescence is a sufficient mark for the very natural genus *Leontopodium*, of which several new forms, chiefly from E. Asia, have been recognised or added since the Compositae were described for the Fl. Brit. Ind. The habit of the present species is remote from nearly all the various types of

Anaphalis, most resembling that of some *Filagos*, while the heads are not unlike some species of *Gnaphalium* or *Micropus*; but the involucral leaves are essentially those of a *Leontopodium*.

Named with reference to the free pappus hairs, which are abnormal in the genus.

558. **Saussurea tanguensis**, *J. R. Drummond* [Compositae-Cynaroideae-Carduineae]; species singularis, nulli adhuc cognitae arctius affinis, approximans autem *S. Thomsoni*, C. B. Clarke, a quâ capitutis late hemisphaericis neque subglobosis, bracteis subcapitularibus basi subtruncatis, suprâ sensim acuminatis nec oblongo-rotundatis apice obtuse acuminatis, phyllariis obovato-lanceolatis acuminatis nec oblongis obtusis, pappo subrigido, scabro potius quam plumoso, nitide purpureo, nec albido, facile distinguitur.

Herba saepe nana, at nonnunquam elatior, rigida, caudiculis 1–4 robustis, ad 3–8 cm. longis, foliorum vetustorum petiolis vestitis ex rhizomate perenni sublignoso 10 cm. longitudinis attingente ortis. *Caules* annui e summis caudiculis ascendentes, foliosi, vel paucis foliis donati, subscaposi, aliquando ad 22 cm. producti, saepius abbreviati, vel fere deficientes, uniflori. *Folia* in caulis inferiore parte subcoriacea vel plus minus carnosa, 3–6 cm. longa, 5–10 mm. lata, spathulato-oblonga, inferiore parte in petiolum laminam subaequantem sensim attenuata, apice obtuso vel obtuse acuminato, margine remote denticulato, pilis glandulosis obscure conspersa vel fere glabra, supra modo bractearum quasi verticillata, et tunc ovato-lanceolata vix 15 mm. longa, capitulum plus minus arcte amplectentia, omnia minute rugosa, subflavide virescentia. *Phyllaria* lineari-oblonga, obtuse acuminata, pilis glandulosis satis sparse densius ad marginem obsita, flosculos subaequantia; capitulum diametro 3 cm. attingens. *Flosculi* tenuissimi, circa 8 mm. longi segmentulis abbreviatis, tubo supra albo-hispido, lobis stigmaticis exsertis. *Pappus* duplicatus fragilis, exteriore serie setis scabris brevioribus ferrugineis, interiore paucis flosculum vix aequantibus scabriusculis nitide purpureis, consistente: (achaenia curculionibus vastata, non sunt visa).

India. Eastern Himalaya: hill behind Tangu Bungalow, 4920 m., *Younghusband*; The La, 4600 m., *Smith* and *Cave*, 2161; Tongsong La valley, 5080 m., *Smith* and *Cave*, 2357.

A singular form unlike any other species save *S. Thomsoni*, C. B. Clarke, and some forms of *S. bracteata*, Decaisne, from both of which it differs in the structure of the head and colour of the pappus.

559. **Aristolochia Curtisii**, *King MSS. ex Gamble* [Aristolochiaceae]; species *A. hastatae*, Jack, sumatranae affinis; ob folia profunde triloba pedatim 7–9-costata distincta.

Frutex scandens, parvus; rami suberosi; ramuli sulcati, torti, glabri. *Folia* chartacea, glabra, juniora late hastata, ad 10 cm. longa, 16 cm. lata, adulta profunde digitatim triloba, basi cuneata, pedatim costata, 10–20 cm. longa, 10–30 cm. lata, lobo medio oblongo-lanceolato, acuminato, lateralibus spathulatis apice rotundatis incurvis, marginibus integris, costis lobi medii 3 centrali ad apicem attingenti, lateralibus submarginalibus, costis loborum lateralium 2 nervos paucos emittentibus, venis transveris multis reticulantibus; petiolus gracilis, canaliculatus, 5–10 cm.

longus. *Flores* in racemis 1–3 axillaribus conspicue bracteatis ad 5 cm. longis; rhachis angularis; bracteae amplexicaules, rufescentes, ovato-acuminatae, 1–1·5 cm. longae; flores cyanei et punicei. *Perianthium* 4–5 cm. longum, puberulum, basi oblongum, inflatum, inde cylindricum, ore bilabiatum, labio superiore parvo, inferiore elongato ad 2–2·5 cm. longo. *Stamina* 6, sessilia, styli columnae adnata; antherarum loculi distincti. *Stylus* in columnam brevissimam productus, in discum 6-lobum, 6-apiculatum desinens. *Capsula* oblonga, obtusa, 4 cm. longa, 6-costata, costis junioribus alatis.

Malay Peninsula. Penang: in dense forest, *Curtis*, 330; *G. King*; *Kunstler*, 1453.

560. **Aristolochia minutiflora**, *Ridley MSS. ex Gamble* [Aristolochiaceae]; species *A. indicae* et *A. Tagalae* affinis, sed floribus minoribus et fructu et seminibus distincta.

Frutex scandens, gracilis; ramuli suberosi, sulcati. *Folia* membranacea, glabra, integra, ovata vel ovato-lanceolata, apice acuminata, basi profunde cordata, auriculis sursum dilatatis rotundis introrsum convergentibus, 5–15 cm. longa, 3–7 cm. lata, pedatim 5–7-costata, costarum pare lateralium interiore fere ad apicem extenso, nervis e costâ media 2–3 cum reticulatione obscuris; petiolus gracilis, 3–5 cm. longus. *Flores* in racemis paucifloris puberulis 1 cm. longis; bracteae vaginantes ovato-acuminatae, 3 mm. longae. *Perianthium* 1·5 cm. longum, basi globosum, inde curvatum et labiatum, labio superiore bifido, inferiore producto torto lineari. *Stamina* 6 minutissima, styli columnae adnata. *Stylus* in columnam brevissimam productus, in discum 6-lobum et 6-apiculatum desinens. *Capsula* obovata, 2–5 cm. longa, 6-costata et prominenter transverse rugosa. *Semina* pyriformia, concava, 1 cm. longa, cum placenta cymbiformi crustaceâ dehiscentia; testa rugosa; albumen carnosum.

Malay Peninsula. Perak: in dense forest, *Ridley*, 8022, 10,259; *Kunstler*, 1964.

Var. **dolabrata**, *Gamble*; varietas distincta, perianthii labio superiore ad 3 mm. longo et lato, labio inferiore ad 1 cm. longo; in alabastro labia cum tubo dolabram simulantia.

Malay Peninsula. Perak: in the mountains up to 1000 m. alt., *Wray*, 2997; *King's collector*, 2969.

XIV.—ADDITIONS TO THE WILD FAUNA AND FLORA OF THE ROYAL BOTANIC GARDENS, KEW: XI.

ANNELIDA.

Oligochaeta.

Rev. Hilderic Friend.

The species of annelids found in the Royal Botanic Gardens, Kew, fall into four groups. There are first the British earthworms known as Lumbricidae, of which some thirty species are indigenous in our islands. Then come the foreign worms, belonging chiefly to the Perichaetidae and Geoscolicidae. Next we may mention the smaller worms found in soil, leaf mould, and among decaying bulbs,

a group which has so far been but little worked, known as Euchytraeidae ; and finally the water worms, among which much yet remains to be done.

No addition has been made to the Euchytraeids since the first list was issued, and only one species to the list of water worms. The chief work has been done among the larger species, both British and foreign ; and, as the nomenclature of the former has been undergoing revision of recent years, I propose to give a complete list of the Lumbricidae found in the Gardens up to date, marking those already recorded with an asterisk, and supplying notes where points of special interest are involved.

So far as the foreign species are concerned I shall be content to add the names of any newly found species, with such notes as may be desirable ; referring the reader to the former list for such as have already been recorded. Following the order adopted in that catalogue, we have to add the under-mentioned.

Limnodrilus sp. Coll. H. F., August 4th, 1909, in putrid soil, on the margin of the Lily pond near the North Gallery.

Perichaeta nipponica, *Beddard.* Monogr. Olig. 413. Coll. J. Lambourne.

***Trichochaeta hesperidum**, *Beddard.* Monogr. Olig. 647. This worm was first described from a specimen found at Kew. As the description was based on a specimen whose girdle had not been formed I am glad to be able to complete the description. This annelid contains 180 segments, and is 3½ inches long in alcohol. When living it extended from 4 to 8 inches. The girdle occupies segments 14 to 21, and on three of the segments (18–20) is a white band which corresponds with the tubercula pubertatis in *Allolobophora.* The nephridiopores are large, especially on the girdle, and open in a line with the 3rd seta (Fig. 1). The neutral setae from the region of the girdle to about the 50th segment are paired. Propagating pits. Coll. J. Lambourne.

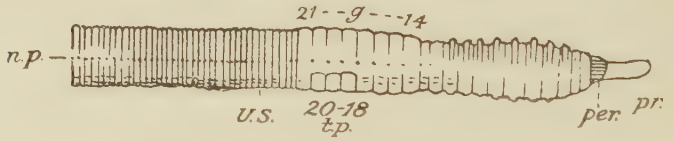

Fig. 1.

Fig. 1. *Trichochaeta hesperidum*, Beddard. × 2., *g.* girdle (14–21) ; *per.* peristomium ; *pr.* prostomium extended ; *t.p.* (18–21), tubercula pubertatis ; *n.p.* nephridiopores, lateral view ; *v.s.* ventral setae, paired in anterior portion of body.

I have also received a set of very delicate worms, from the pits, collected by R. G. Simpson, which appear to be Geoscolicides ; but as they always arrive dead and sadly distorted, I have so far been unable to obtain a satisfactory diagnosis.

Lumbricidae.

I turn now to the Lumbricidae. Among the additions are one or two of special interest, to which attention will be called in the

notes. A few British species have so far not been found, as, for example, *Lumbricus festivus*, Savigny, *Dendrobaena mammalis*, Savigny, and *Allurus tetraedrus*, Savigny.

*Lumbricus terrestris, *Linn.* (= *L. herculeus*, Dugès of former list.)

*Lumbricus rubellus, *Hoffmeister.*

Lumbricus castaneus, *Savigny.* The smallest species of *Lumbricus* found in Britain.

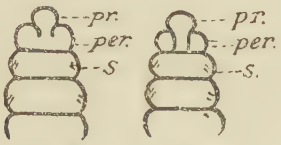

Fig. 3. Fig. 2.

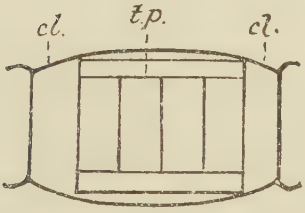

Fig. 4

Fig. 5.

Fig. 2. Head of *Lumbricus.*
Fig. 3. Head of *Allolobophora.*
Fig. 4. Girdle of *Lumbricus.*
Fig. 5. Diagram of *Lumbricus.*

pr. prostomium or head; *per.* peristomium or first body ring without setae; *m.p.* male pores on 15th segment; *cl.* clitellum or girdle bearing tubercula pubertatis (*t.p.*).

*Allolobophora longa, *Ude* (= *A. terrestris*, Bedd., of former list). Constantly confused with *Lumbricus terrestris*, on account of similarity in size and distribution. They may at once be distinguished by observing the position of the girdle and tubercula. *See* illustration (Diagram Cells).

Allolobophora trapezoides, *Dugès.*

Allolobophora turgida, *Eisen.*

These two worms are very closely allied, and are frequently referred to *A. caliginosa.* The specimens from Kew, however, are very distinct. In addition to the native forms we have them in Wardian cases from the Chatham Islands, September, 1909. Coll. C. P. Raffill and H. Green.

*Aporrectodea chlorotica, *Savigny* (= *Allolobophora chlorotica*, Vejdovsky, of former list). This worm is distinguished by the presence of three pairs of pores instead of a band on the girdle, forming the tubercula pubertatis and three pairs of spermothecae.

*Bimastus constrictus, *Rosa* (= *A. constricta*, Rosa, of former list).

Dendrobaena arborea, *Eisen.* First recorded for Kew, September 3rd, 1909. Herbaceous ground. Coll. M. Free.

Dendrobaena subrubicunda, *Eisen.* Received with the last. Coll. M. Free.

Dendrobaena octoedra, *Savigny*. First recorded for Kew, September 16th, 1909. Herbaceous ground. Coll. M. Free.

***Eisenia foetida**, *Savigny* (= *Allolobophora foetida*, Eisen, of former list).

Eisenia rosea, *Savigny*. Though a native of Britain it has also been received from the Chatham Islands, September 2nd, 1909. Propagating pits. Coll. H. Green.

Eisenia veneta, *Rosa*. Though we have several well marked varieties of this interesting annelid, the type was not known in England till I received it from Kew, on September 3rd, 1909. Herbaceous ground. Coll. M. Free. (*See* Gardeners' Chronicle, October 9, 1909, p. 243, fig. 108.)

Octolasion studiosum, *Rosa* (known as *Allolobophora studiosa*, and *A. profuga*). One specimen received from Kew in February, 1910, which differed greatly from the type in colour when living, but not distinguishable from it in alcohol. Propagating pits. Coll. J. Lambourne.

Dendrobaena submontana, *Vejdovsky*. This was first received in September, 1909, at which time it was not perfectly adult. I published a description in the Gardeners' Chronicle of January 29th, 1910 ; but shortly afterwards was favoured with another consignment which contained an adult specimen. This shewed the tubercula pubertatis clearly on segments 28 to 30 : a point of great interest because it definitely proves the species to be quite distinct from *Eisenia veneta*, Rosa, which it greatly resembles outwardly. In *E. veneta* the tubercula are on 30 and 31, and there are internal differences as well. *See* illustration in Gardeners' Chronicle, January 29th, 1910, p. 74, fig. 42. Propagating pits. Coll. H. E. Downer.

An addition of at least a dozen new species in less than a year is not a mean record, and says much for the enthusiasm and careful observation of the young gardeners, to whose services I am so greatly indebted.

COLEOPTERA.

W. E. Sharp.

(*British species.*)

Geodephaga.

Harpalus aeneus, *F.* Herbaceous ground. Coll. M. Free. A very common ground beetle.

Carabus violaceus, *L.* Fern houses. Coll. E. W. Morse. Generally common in the London district.

Pterostichus madidus, *L.* Propagating pits. Coll. R. Joyce. Very abundant and widely distributed.

Hydradephaga.

Hydroporus planus, *F.* Propagating pits. Coll. H. Ruck. One of the smaller water beetles, widely distributed in Britain.

Dytiscus circumflexus, *F.* Tank in Nursery. Coll. W. Dallimore. One of the larger species, occasional in standing water throughout the London district but not common and restricted in range to the south of England.

A larva of another and commoner species of the genus, *D. marginalis*, L., has been taken in one of the outside Lily tanks. Coll. C. P. Raffill.

The presence of both these species in such circumscribed waters is explained by the fact that the perfect insects fly readily and frequently, and often alight and deposit ova in quite superficial pools.

Serricornia.

Ptilinus pectinicornis, *L.* Arboretum. Coll. W. Dallimore. A not uncommon species where larvae bore into palings, gate posts, &c., and very frequently into the dead timber of standing beech.

Lassioderma serricorne, *F.* In small white beans in propagating pits. Coll. H. Green. Like several species which have been taken here, this is a cosmopolitan insect whose larvae, feeding as they do on various seeds and roots (ginger, liquorice, &c.), are carried about the world by commerce. There is no reason to doubt that the species was thus imported with seeds of some kind to Kew, and although normally a 'British beetle' has no real claim to a place in the British fauna.

Clavicornia.

Necrophorus vespillo, *L.* Bulb pit. Coll. R. Joyce. One of the 'burying beetles' which deposit their ova in dead animals, and whose larvae feed on carrion; generally distributed in Britain.

Heteromera.

Helops striatus, *Fourc.* Propagating pits. Coll. H. E. Downer. A very common British species, often found under bark, especially of dead fir trees and usually in dry and sandy localities.

Rhyncophora.

Scolytus destructor, *Ol.* Arboretum. Coll. W. Dallimore. One of the wood-boring weevils, common and very injurious to elm.

(*Exotic species.*)

Exechesops jordani, *W. E. Sharp.* Coll. H. Green. This very distinct and interesting species was discovered among seeds of a Lily imported from Tanganyika, Africa. Previous to its description the genus *Exechesops* contained but five species only, one of which (*E. monstrosus*, Pasc.) was a native of Africa. The present species is much larger than any of the others, and its exceedingly prominent eyes give the insect a remarkable aspect.

The nearest British ally to *Exechesops* is perhaps *Macrocephalus albinus*, L. A very rare species found occasionally in decaying wood.

Ptilodactyla sp.? Coll. H. Green. This *Ptilodactyla* appears to have become provisionally established in our orchid houses, specimens having been taken at intervals during the last two or three years. *Ptilodactyla* is a Central and South American genus and also occurs in some of the West Indian Islands. Our species bears a close resemblance to *P. probanda*, Kirsch., but is probably undescribed as there are no named examples of it either in the collections of the British Museum, or those of the Zoological Museum of Dresden, which latter contains most of the species of *Ptilodactyla* known to science.

No doubt the Kew species was originally imported with some orchid from tropical America.

XV.—MISCELLANEOUS NOTES.

Mr. Ernest Samuel Dodd and Mr. Ernest Edward Mawer, members of the gardening staff of the Royal Botanic Gardens, have been appointed by the Secretary of State for India in Council, on the recommendation of Kew, probationer gardeners for service in India.

Dr. Peter MacOwan, F.L.S.,—We are indebted to Dr. S. Schönland, Director of the Albany Museum, Grahamstown, Cape Colony, for the following obituary notice of the late Dr. MacOwan, F.L.S., who died at Uitenhage, Cape Colony, on December 1st, 1909. Dr. MacOwan was a frequent and highly valued correspondent of Kew, and the South African collections in the Herbarium have been very considerably augmented through his instrumentality. The genus *Macowania* was named in his honour by Prof. D. Oliver in 1870.

The son of a well-known Methodist minister, MacOwan was brought up in a very hard school which would have crushed any less elastic spirit. This hard school was, unfortunately, continued more or less through his long life, in which he never found work with congenial surroundings or worthy of his exceptionally high abilities. It was his sad fate to have to devote the best years of his life to mere drudgery, small wonder then that he at last made drudgery the main business of his life, and found relief occasionally in satirical writings which sparkled with knowledge and wit. However, only few of these were published under his name.

He was born at Hull, November 14th, 1830, educated at Kingswood College and Islington Grammar School. At the age of 16 he became a tutor at Bath, thence passed to Colchester in 1849, and became housemaster at the great Wesleyan School at Woodhouse Grove, near Leeds, in 1853. In 1857 he accompanied Dr. Samuel Sharpe, the Headmaster, to Huddersfield College, taking duty as tutor in Chemistry, and graduating in London University the same year.

Having to earn his own living at such an early age, I cannot understand how he amassed the encyclopaedic knowledge which he

undoubtedly possessed. He was a good classical scholar, finding recreation up to near the end of his life in the study of the best Latin and Greek authors; he had a rare acquaintance with the best English literature in almost all its branches; he read and spoke French fluently, and had a good acquaintance with German. While in England, he took a great interest in archæological studies, and made large collections of brass-rubbings and impressions of seals and coins. Some of these brass-rubbings and all his impressions of seals are now in the Albany Museum. They are prepared with a patience and skill which could hardly be excelled. This habit of preparing specimens with his own hands in the most scrupulously careful manner clung to him through life, and the tens of thousands of botanical specimens which he distributed gratis to the leading herbaria of the world will testify to this. It made him, however, averse to employing any assistance for mechanical work except very late in life. Already in England he had begun to study Botany. He took up especially Phanerogams and Mosses. In 1860 his health began to give way, lung-troubles appeared, and in 1861 he left Huddersfield to take charge of a projected "College" at Grahamstown. Fortunately, his health was already restored during the sea-voyage, and he never again had any serious illness until late in life. The promoters of the "College" named Shaw College had no clear idea what they wanted and it was never more than a school; besides, as MacOwan put it, "When it was projected wool was up, and when he came out wool was down." Little of the expected financial support was forthcoming, and he had a hard struggle to keep the school going. However, from an educational point of view, his efforts were crowned with success. Although a stern master, his former pupils to this day speak of him in the most affectionate terms, and it cannot be a mere coincidence that many men who passed through his hands in Grahamstown, and later at Somerset East, have been most successful in after life, and are noted as amongst the ablest and most upright men in South Africa. In Grahamstown he enjoyed the intimate friendship of Dr. W. G. Atherstone, Mr. H. Hutton and Mrs. F. W. Barber, all of whom took a keen interest in Botany. He got into touch with Dr. (now Sir Joseph) Hooker, the late Dr. Harvey, the late Dr. Sonder, the late Prof. Asa Gray and other eminent botanists, all of whom encouraged him in his efforts to explore the flora of Grahamstown and the surrounding country. He laid here the foundations of his herbarium, and by his own collections and through exchanges, soon accumulated an enormous quantity of valuable material. Harvey paid him a grateful compliment in the preface to the third volume of the "Flora Capensis."

He left Grahamstown in 1869 to take up the post of science tutor at Gill College, Somerset East. This institution was expected to become a kind of University College for the Eastern Province of Cape Colony, but the time was not ripe for such an institution, besides circumstances over which he had no control and which we, looking back, can perceive clearly, made it from the first a hopeless failure. It took, however, many years before his enthusiasm was checked. He presented his herbarium to the

College, and mounted every single specimen with his own hands; he also made valuable zoological and other collections, a very fine beginning of a museum, for which he obtained a government grant through his influence with Sir Henry Barkly, the then Governor, who was in frequent friendly communication with him on botanical subjects. At Somerset East besides exploring the phanerogamic flora, he began to give special attention to Fungi and Lichens, and thus began his association with Kalchbrenner, Cooke and Lojka to which we owe to this day the greater part of our knowledge of South African Fungi and Lichens. He was a skilful microscopist, and gradually accumulated a fair amount of literature on the branches of Botany in which he was interested, besides a large amount of authentic material for comparison; but he very seldom liked to assume the responsibility of describing new species of plants, of which he discovered quite a host. He always preferred to send them to some specialist, frequently with complete diagnosis. From the time with which we are dealing dates approximately also his association with Dr. H. Bolus, who was then residing at Graaff Reinet.

In 1881 he was appointed Director of the Capetown Botanic Gardens, Curator of the Cape Government Herbarium, and shortly afterwards became in addition Professor of Botany at the South African College. It may here be mentioned that after he left Somerset East his herbarium was entirely unused, and it was a great joy to him when in 1904 the Trustees of Gill College were induced to present it to the Albany Museum. Although it had evidently dwindled down somewhat, it still contained 14,000 sheets of Phanerogams (many of them priceless types from most parts of the world) and 1,800 Fungi.

With his appointments at Capetown he seemed at last to have got the reward of hard work, and a sphere for the display of his abilities. The tasks before him, although beyond the power of the average man, would not have dismayed him if only they had been normal. His average working hours, up to late in life, were at least ten a day (Sundays and public holidays included), but he had been set impossible tasks. The so-called botanic garden was in the main a trading establishment aided by a small government grant on ground quite unsuitable for a true botanic garden and badly provided with water, &c. At the College there were no instruments, no books and no other aids in teaching. He supplied the most necessary things at his own expense. In those days the study of Botany did not "pay" in the University examinations at the Cape, and in any case the number of students would have been small. That the classes had to be given up after about half a dozen years was not altogether his fault. He had to submit to the force of circumstances. One of his former pupils, Dr. Juritz, in describing this phase of MacOwan's activities, in the South African Journal of Science (Vol. I, 3) says: "In facility of illustration and apt quotation he was not easily matched, and, when some obscure point needed elucidation, he was as ready with a humorous anecdote at one moment as he was with an appropriate passage from the Greek classics at another. Now it would be Homer, and then Oliver Wendell Holmes, for with both he had an equally intimate

acquaintance, and one or other of these stores of culture and learning seemed always at call when he wished to point a moral or adorn a tale. The Philosopher was many a time summoned from his breakfast-table and, what is more, from that "vasty deep" he seemed to come, and to enter into the actual being, fibre and marrow, of the speaker, so that the latter appeared his very *alter ego*. Under such circumstances, it is needless to remark, the botanical class-room was the very antithesis of being dry-as-dust; the lectures sparkled alternately with satire and humour, while quotation, anecdote and reminiscence combined to drive home many a point which but for those associations would perchance have passed unheeded through the sieve-like student-mind. His black-board diagrams—like his word-paintings—were generally rapidly accomplished by means of the fewest possible master-strokes, but whenever these were made they pithily conveyed the exact impression intended, and he was a dull student who would remain untouched by the Professor's almost boyish enthusiasm."

The affairs at the botanic gardens were quite pathetic. Instead of directing a scientific establishment he had to carry on a precarious retail-business in plants and seeds, and it is much to his credit that when he left in 1892, he could hand it over to the Municipal authorities with a small credit balance although he carried out a number of costly improvements which to a large extent had been paid for out of money earned by him. The reports which he presented to the Government made his position clear from year to year. To anybody acquainted with the local circumstances they are very interesting, and the grim humour frequently displayed by the writer would be amusing if it had not been a transparent cloak of his sorrows and anxieties.

As far as Government support and the interest of the general public were concerned the herbarium was naturally the Cinderella of the three departments over which he presided. As might be expected, he devoted all his spare-time to it. When he took it over it was fearfully neglected and badly housed, in fact practically condemned as mere lumber. It was not until 1892 that a couple of decent rooms could be assigned to it. He gives a short retrospect in his report for that year:—"The total number of cabinets is now thirty-one, as against seven, which was the number in 1881, and contained the study-set as far as *Campanulaceae*, mounted by Dr. Harvey in 1864. These figures show that, scanty as has been the leisure left to the Curator till recently, the whole collection has been more than quadrupled. In accounting for this large increase by intercalations, it must be remembered that the basis of the herbarium once the property of Zeyher, and afterwards of Dr. Pappe, consisted of collections made from about the year 1825 to 1849, and the specimens, besides being very old, had suffered much from neglect and unskilful curation. Even the study-set, selected and mounted by Dr. Harvey, was allowed to lie for several years without being treated with sublimate to prevent insect depredations. This most simple of precautions was at last enforced by Sir Henry Barkly, soon after his arrival from Mauritius, on finding the extent to which the mischief had proceeded. Under these circumstances the obvious course for the present Curator was, first

to go through the whole series, taking nothing for granted and sublimatizing everything, precisely as should have been done after the original purchase ; and next, to supply from his own and other sources additional sheets of authentic specimens supplementary to the older and more or less damaged examples. It is in this way that the large increase in the bulk of the collection has come about. Another excellent result indirectly following is the enlargement of the geographical area represented. It has happened that the localities in which the Curator and his contributory botanical friends have prosecuted their studies for the last thirty years are different from those particularly sought over by Ecklon and Zeyher. It is only since 1878 or thereabouts that the older botanists' happy hunting-grounds in the Cape West and the Peninsula have been beaten once more. Therefore in all these renewals and intercalations, not merely the betterment of the study-specimens has been secured, but also a permanent record of the flora of localities very insufficiently or not at all worked over by Ecklon, Zeyher and Drege."

By 1901 there were 61 cabinets comfortably full. His reference to the additions of his collections is characteristically modest. I can put it a little more plainly by stating that he brought an enormous mass of his duplicates from Somerset East at his own expense, and incorporated them with the Government Herbarium. The herbarium was removed with the Agricultural Department into a building in Grave Street where the accommodation was ample, but the risk of its being destroyed by fire constantly haunted him. As a matter of fact, the adjoining property was destroyed by fire, and the herbarium premises were only saved as if by a miracle, after portions had actually been set alight. At last, the Government granted him a special building at the back of the South African Museum, but to say the least, it was not worthy of the collections it was to house, nor of the man who was to take charge of it. Here, however, he spent his last years before he gave up all official work.

In 1884 he began with Mr. Henry Bolus the issue of the "Herbarium Normale Austro-Africanum." This co-partnership ceased after 15 centuries had been issued. Five more centuries were issued by him single-handed. As these collections were issued gratis a fair return in valuable material accrued to the Cape Government in exchanges. Fortunately, he was able to interest and train a number of enthusiasts who assisted him with South African material, but every one of these will readily admit that he always gave more than he received by naming specimens and help in other directions. Of course, if he had any material to spare Kew always got the first chance. Sir W. Thiselton-Dyer acknowledged this in the preface to the sixth volume of the "Flora Capensis." He says "More than 30 years have rolled away since Prof. Harvey bore eloquent testimony to the indefatigable services of Peter MacOwan, Esq., B.A., F.L.S., then Principal of Shaw College, Grahamstown, now Government Botanist. Time has not staled his enthusiasm for the beautiful Flora amidst which he has spent the best years of his life, nor his energy in investigating it. Without his self-sacrificing aid the present undertaking would have been

miserably incomplete. By a correspondence which has never intermitted, he has done all in his power to keep Kew abreast of the progress of botanical discovery in South Africa. And he possesses the happy art of communicating some touch of his enthusiasm to others, and has thus secured the investigation of many parts of the area of the Flora which might otherwise have remained all but unknown."

MacOwan also distributed study-sets to various schools and did everything in his power to further the study of Botany in Cape Colony schools.

From the very first when he found that I was making an earnest attempt to form an extensive herbarium in connection with the Albany Museum, he sent me everything that he thought might be of use to us, and as years went on, with the risk of fire at the Capetown Herbarium, he deliberately set himself the task of duplicating the Capetown collection as much as possible at Grahamstown. Great was his joy, therefore, when I induced the Trustees of the Gill College to hand over their (or rather his) collection to us, and if to-day the herbarium of the Albany Museum holds an honourable position amongst similar institutions it is to a preponderating extent due to him.

As Director of the Botanic Gardens he was naturally obliged to give special attention to horticultural matters and to Economic Botany generally. It was not long before crowds of people from all parts of South Africa, gardeners, farmers, importers, manufacturers, came to him for advice on all kinds of matters on which he might help them. He also got into touch with the Agricultural Departments of the United States of America, and of the British Colonies, to whom he issued plants and seeds for acclimatisation and from whom he received valuable plants for trial in Cape Colony. I think it was first in 1887 that the Cape Government acknowledged this work by employing him as official Consultant on Economic Botany. From that time he had to pour out a regular flood of reports, many of which were published in the Agricultural Journal of Cape Colony, founded in 1889, while hundreds of them were merely filed. It is not too much to say that those published in the Journal bore evidence of wide acquaintance with the literature of the subjects dealt with, of a fairly thorough acquaintance with the immensely varied local conditions in Cape Colony, and of keen observation aided by sound common-sense. Besides, they were written in a crisp and sparkling style, interspersed with homely similes and appropriate humorous allusions. For many years they formed a most valuable ingredient of the Cape Agricultural Journal. He hit out pretty hard sometimes when ignorant people, who ought to have known better, pestered him with enquiries, but he had an immense circle of friends amongst his readers, who welcomed everything "The Professor" was publishing, and I may add, many of them followed his advice with great advantage to themselves. He was particularly severe on all those who practised slovenly methods and, although he sometimes did not gauge practical difficulties sufficiently, much of the improvement in cultural matters which has taken place in recent years on Cape Colony farms, is due to his persistent preaching.

At the end of 1891 he resigned the Directorship of the Gardens and became Government Botanist, retaining the post of Curator of the Herbarium. These appointments he held until his voluntary retirement in 1905.

It has already been indicated that the farming community of Cape Colony owed MacOwan a great deal. Two of his achievements stand out from many others. He first introduced the Australian salt-bush and found the right man, Mr. E. Alston, to spread it. Thus many acres of valueless brak land have been turned into valuable pasture, but above all Cape Colony owed to him more than to anybody else the introduction of fruit-culture on a big commercial scale, and it seemed hard that his great services remained unacknowledged, while others reaped the reward of his labours. To do him justice I must add that he himself felt fully rewarded in the consciousness of doing his duty to the country of his adoption. He never cared for official honours, and when in 1904 the University of the Cape of Good Hope conferred upon him the degree of D.Sc., honoris causa, he only accepted the honour because he was afraid that by refusing he would give offence to the kind friends who had secured it for him. He had been a member of the Council of the University almost from its inception and acted for a number of years as one of its examiners. He also joined the South African Philosophical Society (now the Royal Society of South Africa) at its formation in 1876 and was for many years one of its most active members. In 1885 he was elected its President, but as years went on and especially when bodily infirmities made themselves felt, he became more and more a recluse. When the South African Association for the Advancement of Science was formed in 1903 he wrote to me :—"All these tokens of the awakening of the scientific spirit have come too late to be of any use to me. I am content to keep quietly on in the old groove and shall think it enough to have built up a good herbarium out of next to nothing."

He never visited England after he had come out here, and even in South Africa he did not travel much. There was never any time for it.

For a couple of years after his retirement he worked daily for 6 or 7 hours at the herbarium of the Albany Museum, chiefly putting the Gill College collection into excellent order again. In his private life he had many cruel trials and disappointments to which no reference can be made here, but his spirits had remained almost boyish, as Dr. Juritz rightly put it, until about five years ago. Two years ago he had a slight stroke of paralysis and finding the climate of Grahamstown rather too cold in winter he removed to Uitenhage. The end came gradually though not unexpectedly. He met it in the same philosophic spirit in which he had gone through life. He left a son and two married daughters with their families to mourn his loss.

His work was chiefly pioneering work in a "new" country, but I venture to think that should the true history of South Africa ever be written an honourable place will be occupied in it by MacOwan's work.

S. Schönland

Angola Rubber (*Carpodinus gracilis*, Stapf).—Under the heading "Rubber Production in Angola," an article appeared in a recent number of the Board of Trade Journal, from information supplied by Mr. H. G. Mackie, H.M. Consul at Loanda, in which it is stated that the above-mentioned plant is the source of "Wild Rubber" collected in that region.

In Flora of Tropical Africa, vol. iv. p. 84, Dr. Stapf describes this species of *Carpodinus* as a dwarf, somewhat prostrate shrub, distributed in Lower Guinea and South Central Tropical Africa, and on p. 599 states that (according to De Wildeman and Gentil) the latex is useless. Several species of this genus are, however, known to yield good rubber, including *C. lanceolata*, which is stated to be the source of most of the root rubber of the Congo.

From the article in question, it appears that careful investigations have been conducted by a Government botanist in the regions lying between the rivers Cutato and Cutchi and the Cubango and Cului on the plateau of Benguella. Among the numerous latex-yielding plants collected, the most promising rubber plant is said to be a shrub (*Carpodinus gracilis*), growing in shady places on a soil with no rocks or stones, but having a deep layer of sand free from stagnant water. This shrub furnishes a rubber of good quality, which is extracted by the natives by beating the rhizomes (horizontal stems) between two pieces of wood—one having a flat surface and the other shaped like a mallet. The bark is thus separated from the wood and reduced to fragments, held together by the rubber in the tissues, the globules of caoutchone coagulating as soon as they come in contact with the air, and thus none of the latex is lost. As soon as the bark that contains the rubber is peeled off, the native continues the beating operation until the whole is reduced to a spongy elastic mass, known in the trade as a "manta" or sheet. The "manta" at this stage consists of the rubber threads binding the broken bark that has been reduced to powder. It is now worked in cold water and again beaten. Repeating this working and beating process, the native is able to prepare a physically almost pure rubber, at the expense, however, of great labour. For this last reason it does not always pay him to clean the rubber too much. After this working and beating process, the spongy mass turns into a flaccid rubber sheet of less than half an inch in thickness and sometimes as much as 4 feet square. The rubber sheet is now steeped in boiling water for some five minutes, when it becomes quite plastic, and in this state is shaped by hand into its characteristic sausage-like form of about 10 inches in length. Although the water is pressed out as much as possible during the modelling operation, the rubber still contains 30 per cent. of moisture, which must, of course, be evaporated if the rubber is to be preserved from damage. The drying of the rubber has to be attended to by the buyer. The native frequently collects large loads of stems and rhizomes in the cold and dry season far away from his village, and the loads are brought in and stored for weeks before the rubber is extracted. If there is much dry material to work, it is immersed overnight to render the bark more malleable and less adherent to the wood.

The rubber in question is classified as second-class rubber in Angola, as it is usually badly cleaned, *i.e.*, full of particles of bark.

A first-class product could be obtained from this plant in Angola if the natives would take the trouble to clean the rubber more than they do.

One-fifth of the ground traversed by the Government botanist between the Cubango and the Quembo, an affluent of the Cuando, is covered by this plant, from 16 degrees south latitude, to the Congo basin ; it thrives better, however, in some localities than in others.

The root rubber industry, entailing a great amount of manual labour, is essentially a black man's industry, but the methods of extracting and preparing the rubber leave much to be desired. The employment of machinery, would, no doubt, help to solve the problem, but the lack of means of communication is at present the chief obstacle to the attainment of a higher standard. Moreover, the country is not yet occupied, and the natives are much too uncivilised at present to admit of much improvement.

Rubber is gathered over a vast expanse of country by the natives, who carry it on their heads to the up-country stores where they barter it for other goods. These stores are situated in the populous centres and follow up the trade, the merchants moving from one district to another, as circumstances may require. In 1903, a European bought 26,500 lbs. of rubber in the populous valley of the Cuango, an affluent of the Kuito; soon afterwards three Portuguese factories started business on that river. The produce is likewise brought in by Boer wagons, the Portuguese traders using these conveyances for penetrating into the unoccupied regions for hundreds of miles.

J. M. H.

Botanical Magazine for March.—The plants figured are : *Rehmannia Henryi*, N. E. Brown (t. 8302); *Aquilegia alpina*, Linn. (t. 8303); *Rhododendron mucronulatum*, Turcz. (t. 8304); *Pittosporum Colensoi*, Hook. f. (t. 8305); and *Notylia trisepala*, Lindl. (t. 8306).

The *Rehmannia* was first discovered in Central China by Mr. Augustine Henry, and during Mr. E. H. Wilson's last visit to the same region seeds of it were collected for the Director of the Arnold Arboretum through whom the plant has been added to the Kew collections. It was originally identified with *R. Piasezkii*, Maxim., but further examination shows that it is distinct from that species. Its large flowers are yellow or yellow and white, with numerous minute red specks chiefly on the corolla-tube. The plant introduced into cultivation a few years ago as *Rehmannia angulata*, Hemsl., and figured at t. 8177 of the Botanical Magazine, is provided with a new name, *R. elata*, N. E. Brown. It differs from the true *R. angulata* in being twice as large, in having differently lobed leaves and larger differently coloured flowers. *Aquilegia alpina* is a native of the Alps and the Apennines, and the plant figured, which flowered in the garden of Mr. D. Hill, of Watford, was obtained by Mr. A. W. Hill on the Pleine Madeleine, near Chandelon, in Valais. It has large blue-violet flowers. The *Rhododendron* is a pretty species belonging to the same group as

R. dauricum, Linn., from which it is distinguished by having larger thinner acute leaves, which fall off before the flowering stage, and larger more numerous flowers. The Kew plants were obtained by purchase from a firm of nurserymen in Yokohama in 1907. *Pittosporum Colensoi* is a New Zealand species which, though tender in most parts of the United Kingdom, flourishes out-of-doors in the gardens of Mr. T. A. Dorrien Smith, Tresco Abbey, Isles of Scilly, from which the material for the figure was sent. *Notylia trisepala* is a small epiphytic orchid with a long pendulous raceme of very small pale green flowers, and is a native of Mexico. The specimen figured flowered in the garden of Mr. W. E. Ledger, at Wimbledon, and was presented by him to the Kew collections.

The Stem Bleeding Disease of the Cocoanut.—A well illustrated account of a serious disease of the Cocoanut, by Mr. T. Petch, is contained in Circular No. 22 of the Royal Botanic Gardens, Ceylon. The leading symptoms of "Bleeding disease" are the exudation of a dark-coloured sap from cracks in the "bark." This sap is somewhat viscid and gradually forms a patch of perceptible thickness, which soon turns black. These patches vary much in size, being sometimes quite small, in other cases several feet in length and 6 inches or more broad. The effect of the disease varies much with the age of the tree, and the injury is most severe up to 40 years of age, and in severe cases the disease hollows out the stem almost to the bud, yet without killing the tree. In trees under 10 years old, the external patch is usually quite small, and gives no indication of the extent of internal decay, which may be very considerable. On trees over 40 years old, although the patches may be numerous, the substance of the trunk is not materially injured, the "wood" being generally so hard that it resists the attack of the fungus. An extensive series of cultures and inoculations have proved the disease to be caused by a fungus named *Thielaviopsis paradoxa*, v. Höhn. (*Thielaviopsis ethaceticus*, Went.), a well-known parasite of the sugar-cane.

Notwithstanding the serious nature of the disease, the trees are rarely, if ever, killed outright, neither is there any material diminution in the crop, even when the trunk is hollowed out.

All varieties of the cocoanut appear to be equally susceptible to the disease, though the "King cocoanut" suffers more than the others when trees of the same age are considered.

The treatment recommended is to completely cut out the diseased portion of wood, and to cover the wounded surface with coal tar. All diseased portions should be collected and burned, and not allowed to lie on the ground at the base of the trunk.

A short reference to this disease appeared in *K.B.* 1908, p. 310.

A Disease of the Cacao Plant.—*Diplodia cacaoicola*, P. Henn., was described on Cacao from the Cameroons in the year 1896; more recently it has been reported to occur in Ceylon, Java, Samoa, Surinam, West Indies and St. Thomè (West Africa). It may, therefore, be said to be parasitic on the cacao plant wherever it is cultivated to any appreciable extent. Whether the species is

indigenous in the countries in which it is now known to occur or to what extent it may have been transported from one country to another cannot be definitely said.

The fungus attacks both the stem and the fruits of the plant. The disease of the stem is known as "die-back" owing to the fact that when a shoot is affected death commences at the tip and gradually extends towards the base. The younger shoots are usually first affected; later on the disease spreads to the older branches and sometimes even to the trunk. Between the healthy and the dead parts of a branch there is an intermediate zone which may in some cases extend for distance of two feet and on which the black perithecia of the fungus can be seen bursting through the bark. After the branches are dead and even after they have fallen the fungus continues to grow on them and to produce its perithecia in large numbers.

The disease of the pods is known as "brown pod"; it makes its appearance in the form of a discoloured patch at one or other end of the pod or at a wounded surface. The discoloured area increases in size and extends over the greater part of the surface of the pod. Pods may be attacked in all stages. Young pods when once affected with the disease seldom reach maturity; old pods, however, which develop the disease when nearly ripe, may be allowed to ripen and the seeds may be used.

The results of infection-experiments have shown that the fungus can only effect an entrance into the stem through a wound. In the case of the fruit, however, it is thought that, in addition to entering through a wound, the fungus is capable of entering at the stigmatic and at the basal end of the pod.

Diplodia cacaoicola is regarded by some observers as being synonymous with other species:—Griffon and Manblanc (1909) consider *Botryodiplodia Theobromae*, Pat., *Macrophoma vestita*, Prill. and Del., *Lasiodiplodia nigra*, Appel and Laubert, and *Diplodia cacaoicola* to be identical; Petch regards *Botryodiplodia elasticae*, to which he has attributed the later stages of a "die-back" disease of *Hevea brasiliensis*, as indistinguishable from *Diplodia cacaoicola*; Van Hall considers the species of *Diplodia*, *Lasiodiplodia* and *Chaetodiplodia* occurring on Cacao to be identical.

Diplodia cacaoicola is known to be parasitic on the sugar-cane; it is said to grow on *Castilloa* in the West Indies, and also to cause a root-disease of the Cocoa-nut Palm in Trinidad.

Diplodia cacaoicola is at present classified among the *Fungi Imperfecti*; the only form of reproduction known is by means of dark-brown, one-septate spores produced in black perithecia which are borne on the diseased stems and fruits. By analogy, *Diplodia cacaoicola* is expected to be connected with a more highly developed or ascigerous stage and possibly with one or more conidial forms. Among the diseased material received at Kew two conidial forms have been observed to be closely associated with the mycelium of *Diplodia*, the one corresponding with the form-genus *Cephalosporium* and the other with the form-genus *Mycogone*; experiments are being conducted with a view to ascertaining whether these two forms can be connected with *Diplodia*. Cultural experiments are also being conducted for the purpose of determining whether *Diplodia* will give rise to an ascigerous stage.

Until the life-history of the fungus has been completely worked out it will be difficult to suggest proper remedial measures for exterminating the disease; the following, however, are the methods of treatment usually practised :—

By careful cultivation, manuring and pruning, a vigorous condition of growth is induced, since plants which are growing vigorously are seldom affected with the disease.

All wounds made during pruning and such as may arise from other causes are immediately sealed with coal tar or with a mixture of coal tar and clay.

All diseased branches, pods and husks of pods are removed and buried in pits with lime.

The following are references to the more important articles on the fungus :—

P. Hennings.—Fungi camerunenses I.; Engler Bot. Jahrb. Bd. xxii., p. 72.

A. Howard.—Annals of Botany, vol. xv., p. 683, pl. xxvii.

Van Hall.—Dept. van den Landbouw, Suriname, Bull. 21, 1909.

F. A. Stockdale.—"Fungus Diseases of Cacao," Imperial Dept. of Agriculture for the West Indies, Pamphlet Series, 54, 1908.

F. C. von Faber.—"Die Krankheiten und Parasiten des Kakaobaumes," p. 228.

T. Petch.—"Die-Back" of *Hevea brasiliensis*; Circulars and Agricultural Journal, Royal Botanic Gardens, Ceylon, vol. iv., No. 23, 1910.

C. K. Bancroft.

Angsenna Tree Disease.—The Angsenna tree, *Pterocarpus indicus*, Willd., which is used as a roadside and avenue tree in Malacca and Penang, has been attacked by a serious disease which threatens its complete destruction. The trees are quite a feature of Penang, and whether covered with golden bloom or out of flower with their graceful foliage are alike of conspicuous beauty. At Penang, according to information received from Mr. Fox, Superintendent of Forests and Gardens, Penang, about 100 trees have been killed since the disease was first noticed a few years ago. In his letter Mr. Fox writes: "As these magnificent trees are the pride of Penang, and as most of the main thoroughfares are exclusively planted with them, it will be understood what a serious calamity has overtaken them."

It is surmised that the disease is the same as that which carried off the magnificent avenue of this tree along the sea shore in Malacca some 30 years ago.

At the beginning of January, 1910, six specimens of fungi found growing on the trunks or dead stumps of trees that had recently been cut down were received from Mr. Fox with the following information as to the disease :—

"The disease is apparently confined to this tree only, and appears to be propagated sporadically as well as by contact underground. It is a frequent occurrence for a healthy tree situate a quarter of a mile away from an infected one to be attacked. In other cases

several trees will be attacked in sequence. The first sign of attack is one or more of the main branches having a wilted appearance and shedding their leaves; other branches soon follow and generally in less than two months a magnificent tree will be dead. The majority of those attacked are about 100 feet tall with a trunk 4 to 5 feet in diameter. I have noticed, however, a few younger and smaller trees also attacked and killed.

"Specimen no. 6 is interesting, inasmuch as it comes from a tree that had apparently been killed. In cutting it down I noticed that some branches about 10 feet from the ground were quite healthy. I therefore had the trunk cut off above the live portion, and to-day these branches are growing vigorously.

"The method of combating the disease (so far with but little success) has been to cut trenches around the tree and dust with lime and sulphate of copper. Owing, however, to the road intervening on the one side, and a ditch on the other, the trenches have been simply divisions between the trees only. Doubtless the mycelium has travelled under the road."

The fungi have been examined at Kew. Four of the specimens were found to be *Polystictus occidentalis*, Fries, and the two other specimens were *Polystictus floridanus*, Berk., and *Schizophyllum commune*, Fries.

Of these, *Polystictus occidentalis* is the only parasitic species, and but little is known respecting its life history: judging from analogy, however, it seems probable that its diffusion can be effected by wind-borne spores or by underground mycelium spreading from one tree to another. No cure for the disease is known. It is possible that the trees, which are large and presumably old, are becoming too weak to supply the required amount of food and water to the branches, and hence are all the more liable to succumb to the attack of a parasitic fungus. Such a fungus, when once established on old and weakly trees, will readily pass to young and vigorous trees of the same kind. It is suggested that if a trench could be formed around the base of the trunk of the diseased trees and flooded with a weak solution of nitrate of potash or nitrate of soda (preferably the former) about once a week for two months, the disease might be checked. The strength of the solution should be one pound of the nitrate to three gallons of water.

Manihot preciosa.—In the Report of the Agricultural Department, Gold Coast for 1908, p. 24, a reference is made to a Manicoba rubber under the name of *Manihot precosa* planted in 1906. We are informed by the Governor, through the courtesy of the Secretary of State for the Colonies, that the name in question should be *Manihot preciosa*, and that this name has been applied to a variety of Manihot by Mr. Schindler, of Bahia, Brazil, who sent to the Gold Coast the seeds from which the plants have been raised.

Allusion to this supposed species of *Manihot* is also made by Thompson in his report on Gold Coast Forests—Col. Rep., Misc. 66, 1910, pp. 12–13—where it is stated that the plants are said to yield rubber at a very early age, a statement which it has not yet been possible to verify.

Specimens of the leaves of this *Manihot* have recently been received from Mr. A. E. Evans, Travelling Instructor, Gold Coast, and it now appears probable that the plants should be referred to *Manihot dichotoma*, Ule.

Visit to Cobham Hall.—On December 13th a visit was paid to Cobham Hall, near Gravesend, for the purpose of selecting planks of various kinds of timber, which the Earl of Darnley had promised to present for the Forestry Museum. The estate has long been famous for well-grown timber, and competent authorities credit it with producing the largest ash in the country. About the garden, a number of fine ornamental trees were observed, particularly *Ginkgo biloba*, *Quercus Phellos*, *Q. Ilex*, *Taxodium distichum*, *Sophora japonica*, *Sequoia gigantea*, *S. sempervirens*, *Cedrus Libani* and *Liriodendron Tulipifera*. In the deer park and plantations, however, the largest trees were noted. The ground is rather heavy and well suited for ash, oak and sweet chestnut, in fact a large area of land in the neighbourhood is given over to coppice wood, in which ash and sweet chestnut figure largely. Among the park trees conifers were rarely noted, whilst comparatively few were to be seen in the plantations. Hornbeam grows to a large size, while the same may be said of beech and sycamore.

Time did not allow of measurements being taken of the large trees, but Mr. Scriven, the estate agent, kindly furnished me with the dimensions of the following trees, which were taken a short time ago. The girth, except where otherwise stated, was taken at 5 feet from the ground :—

Quercus Ilex	75 ft.	by 15 ft.	10 ins.
„ *Phellos*	83 „	„ 9 „	3 „
Sophora japonica	81 „	„ 10 „	4 „
Ginkgo biloba	73 „	„ 9 „	5 „
Liriodendron Tulipifera	75 „	„ 8 „	6 „
Sequoia sempervirens	88 „		
„ *gigantea*	77 „	„ 14 „	7 „
Liquidambar styraciflua	75 „		
Taxodium distichum	78 „	„ 7 „	4 „
Acer Pseudo-platanus	102 „	„ 17 „	10 „
„ „	91 „	„ 15 „	3 „
Tilia vulgaris	104 „	„ 13 „	2 „
Fraxinus excelsior	144 „	„ 14 „	6 „
„ „	144 „	„ 11 „	9 „
„ „	128½ „	„ 12 „	6 „
„ „	79 „	„ 14 „	9 „
„ „ with curiously twisted trunk, known as the "Twisted Ash"...	116 „	„ 17 „	8 „
Carpinus Betulus	82 „	„ 11 „	6 „
„ „	82 „	„ 8 „	8 „
Fagus sylvatica	97 „	„ 12 „	6 „
Castanea sativa	92 „	„ 14 „	9 „
„ „	82 „	„ 14 „	2 „
Quercus pedunculata	91 „	„ 17 „	2 „
„ „	76 „	„ 12 „	10 „

Ulmus campestris (at 4 feet)	91 ft.	by 17 ft.	1 ins.
Juglans regia	76 „	„ 13 „	6 „
„ *nigra*	67 „	„ 8 „	2 „
Populus nigra	96 „	„ 11 „	4 „
Æsculus Hippocastanum (at 4 feet) ...	87 „	„ 14 „	0 „
Prunus Avium	91 „	„ 12 „	10 „
Quercus Lucombeana	81 „	„ 11 „	10 „
Cedrus Libani	99 „	„ 15 „	5 „
„ „ (at 2 feet)	86 „	„ 19 „	2 „

W. D.

Baobab Trees used for Storage of Water.—Sir Joseph Hooker has called our attention to an account of the manner in which the natives of Kordofan form reservoirs for rain water in the trunks of living Baobab trees (*Adansonia digitata*). The paper by Captain Watkiss Lloyd, late Governor of Kordofan, Soudan, from which the following extract is taken is published in the Geographical Journal, March, 1910, pp. 253-254, with an illustration of the tree on p. 251. The country referred to lies to the west of El Obeid.

"Elsewhere the people are dependent on water-melons and the water they store in baobab trees. The melons are small and almost tasteless, and are grown in enormous quantities amongst the corn. When ripe they are collected in heaps and protected from the sun until required for use.

"The baobab trees have to be carefully prepared for use as reservoirs. The large branches are first cut off near the trunk. If this is not done, the trunk is apt to split as soon as it is hollowed out. A hole is cut in the trunk, generally just above a branch, which serves as a platform for the man who is filling the tree, and the interior is hollowed out. Round the bottom of the tree a shallow basin some 20 or 30 feet in diameter is made, in which the rain-water collects. As soon as there is a storm, the people go out and fill their trees. The water so stored remains perfectly good until the end of the next hot weather, or even longer. A few trees, naturally hollow, have a hole at the top between the branches, and fill themselves, the branches catching the water and acting as gutters. These are called 'lagai,' and are highly valued by the Hamars.

"The Arabs did not invent this method of storing water, but improved on the system of their predecessors, who made the hole in the trunk only 10 or 12 feet from the ground. The present system gives a cistern 20 feet high and from 8 to 10 feet, or even more in diameter. Owing to the labour involved in preparing and filling the trees, water is usually bought and sold, and on the main roads where there is much traffic, as between Nahud and Jebel el Hilla on the way to El Fasher, the capital of Darfur, the people do a regular trade by supplying merchants and travellers with water.

"The bucket, called a 'dilwa,' used by the Arabs deserves mention. It consists of a piece of leather suspended by strings 6 inches long from a piece of wood bent in a circle, to which the rope used for drawing the water is fastened by three of four strings. On reaching the bottom of the well the leather opens out and collects the water, however little there may be."

Though this appears to be the first reference by an English geographer to the process of hollowing out the trunks of Baobab trees so as to serve as reservoirs, it is not the earliest record of the practice of storing water in this fashion in Kordofan. We are indebted to Captain H. G. Lyons, R.E., F.R.S., for having called our attention to a passage in Mr. J. Petherick's account of Egypt, the Soudan and Central Africa, published in 1861. At pp. 208, 209, Petherick says of the Baobab :—" its trunk and even branches, for the most part hollow, are of immense size, the diameter of the former attaining as much as 40 feet . . . .

" These trees, in many parts of the country where water is scarce, form highly valuable natural tanks, and when filled by the rains are carefully preserved and tapped by the natives during the drought, and enable them to inhabit parts of the country which otherwise, for want of water, would be untenable."

The Sand Dunes of New Zealand.*—The New Zealand Government recognising the importance of dune-reclamation, recently engaged the services of Dr. L. Cockayne with a view to the scientific study of the dunes of the Dominion. The report now issued deals mainly with the subjects of dune-formation, dune-movement, and the dune-flora, a knowledge of which is, as the author points out, absolutely essential before any intelligent scheme of reclamation can be discussed.

In New Zealand moving sands are extremely frequent near the sea-coast. Roughly speaking there are in the North Island 290,000 acres, and in the South Island 24,000 acres of dune-area. These dunes are of special interest in that they afford an opportunity of observing what nature has done for their fixation, a study not possible where for many centuries civilisation has modified the conditions.

After the introductory remarks a brief geographical account is given of the New Zealand dune districts. This is followed by the report proper, divided into two sections, (1) Geology and (2) Botany. In the geological section the material and origin of the dunes are discussed, and also their movement and the various forms of dunes that occur. A typical dune has a long windward slope at a variable angle, and a steep leeside which corresponds to the natural angle of rest of the particular sand of which the dune is composed. On the summit of the windward slope sand-binding plants occur. Even a scanty plant-covering checks the wind, and it is pointed out that a knowledge of the effect of obstacles is of great importance in the work of dune-reclamation. A solid obstacle deflects the wind, causes an eddy, and the advancing sand instead of piling up against the obstacle forms a heap at some distance in front. In the case of an open flexible obstacle (e.g., *Ammophila arenaria*) the sand is blown into the interior of the patch, fills it, and finally forms on the leeward side a tongue-like mass. The advantage, in sand-fixing, of a living plant with upright growth over a dead obstacle is obvious.

Most of the usual forms of dune areas are found in New Zealand ;

* Report on the Sand Dunes of New Zealand. By L. Cockayne. New Zealand, Department of Lands, 1909.

ridges and hills, and the irregular mixture of mounds and hollows termed by Cowles the dune-complex. The fore-dune (the well-known ridge by the sea shore) forms in some places an unbroken wall covered by *Scirpus frondosus* or *Spinifex hirsutus*. In addition to the above there is the wandering-dune, the fixing of which is one of the most difficult questions in dune-reclamation. Cliff-dunes, sand-plains, and swamps also occur.

The wind-factor, so important in all dune problems, receives considerable attention, and the various ways in which this factor acts are clearly described. In addition to transporting sand the wind erodes, and it is easy to see that a dune area is in a constant state of change, construction and destruction going on together. Dunes that have become fixed frequently develop, through the irregular growth of the vegetation, sand-mounds and tussocks. The intervening depressions are sooner or later attacked by the wind ; deep gulleys result, the plants are uprooted, and finally the entire sand-hill may be blown away. A very small patch of loose sand may set a dune in motion, and the author remarks that the neglect by the farmer of wounds in the turf is perhaps the greatest source of danger to adjacent fertile lands. On account of the liability of irregular growth great care is necessary in the selection of sand-binders, the subsequent as well as the immediate growth having to be taken into consideration.

An account of the leading New Zealand dune plants with remarks on their life-forms and adaptations is included, and also a description of the plant-associations of Western Wellington, the study of which locality forms the basis of the report. With regard to the plant-associations a physiographical classification is adopted, sand-plains, stony-plains, swamps and true dunes being distinguished. Under the last heading the evolution of the " sand-grass " dune to the fixed dune is traced. The " sand-grass " dunes are distinguished by their instability and by the presence of *Spinifex hirsutus* and *Scirpus frondosus* (the latter being of special interest in that it belongs to an endemic section of the genus).

Calystegia Soldanella, *Festuca littoralis*, *and Calamagrostis Billardieri* are also found, but are of minor importance. Shrubs gradually appear in the formation, and becoming dominant, the second stage in dune development is reached, namely the shrub-dune. The shrubs consist of *Coprosma acerosa*, *Cassinia leptophylla* and *Pimelia arenaria*. The next stage in the process, the heath-dune, is marked by the appearance of *Leptospermum scoparium*. Other plants making up this formation are *Arundo conspicua* and *Phormium tenax*. Finally there is the fixed dune where a large number of plants can grow with *Pteris esculenta* (Bracken) or *Leptospermum* usually dominant. In certain localities these stable dunes are successfully used for crops of oats or rape.

The report, which is illustrated by excellent photographs, forms an interesting account of the general principles upon which dune-reclamation depends. In addition to these principles it is obvious that a thorough knowledge of the special circumstances of the country are necessary before the final report providing a scheme of reclamation and afforestation can be drawn up.

A. D. C.